U. S. FOREST SERVICE

RESEARCH NOTE NC-84

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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SURVIVAL AND GROWTH OF EASTERN REDCEDAR SEED SOURCES IN SOUTHWEST MISSOURI

ABSTRACT. — After five growing seasons on a southwest Missouri outplanting site, trees from a West Virginia eastern redcedar source had better survival, form, vigor, and height growth than trees from eight other sources tested. The local Missouri source, handicapped at planting by an unfavorable top:root ratio, is now growing vigorously.

OXFORD: 232.311.21:174.7 *Juniperus virginiana:* **232.324:232.43(778)**

Eastern redcedar (*Juniperus virginiana* L.) shows much geographic variation in growth rate, form, foliage color, and other traits. In 1961 a study was begun to evaluate trees from several redcedar sources outplanted in six northern and central states for the purpose of finding superior sources for planting in these areas. Early results of the planting in southwest Missouri show that there are differences in tree survival, height growth, and form among the sources.

Methods

Seed collected from 16 sources within the natural range of the species was sown in the fall of 1961 in the George White Nursery in Licking, Missouri.[1] In the spring of 1962 seeds in only 8 of the 16 seed lots germinated. All sources were held in the nursery for another year in the hope of delayed germination, but no additional seeds germinated in the second year. In the spring of 1964 the 2-0 stock from the 8 sources (table 1) was planted on the Ava Ranger District of the Mark Twain National Forest (Taney County). Unfortunately, all of the 2-0 stock was somewhat larger than desired, with top:root ratios ranging from 3.3 to 5.7. Seedlings grown from local seed (Christian County, Missouri) were exceptionally large (fig. 1) because of low density in the nursery bed resulting from poor seed germination. Nursery-run 1-0 seedlings from a Nebraska source were also included in the test plantings. The plantings were laid out in a randomized complete block design with 12 replicates of 15-tree plots. Prior to herbiciding, the planting site supported an oak-hickory stand with a black oak site index of 60.

The seedlings were measured at the end of the first, second, and fifth growing seasons after outplanting. Form and vigor of the seedlings were classified as good, fair, or poor:

Form

Good — a single straight stem
Fair — some crook in the main stem
Poor — one or more forks

[1] *The cooperation of the Missouri Conservation Department in growing the planting stock for this study is appreciated.*

Table 1. — *Characteristics of trees from nine redcedar seed sources 5 years after planting*

Seed source number and origin	Mean survival	Mean height growth	Good form	Good vigor
	Percent	Feet	Percent	Percent
10 Mason Co., northwestern W. Virginia	1/ 80 ± 9	1/ 4.7 ± 0.2	62	72
20 Seward Co., southeastern Nebraska	78 ± 3	3.1 ± 0.2	31	21
9 Buffalo Co., western Wisconsin	65 ± 5	3.1 ± 0.3	25	25
12 Ellis Co., central Kansas	59 ± 5	2.6 ± 0.2	23	1
14 Trego Co., central Kansas	49 ± 7	2.4 ± 0.2	18	14
13 Riley Co., northeastern Kansas	49 ± 5	3.2 ± 0.3	34	5
16 Madison Co., east central Kentucky	41 ± 4	3.3 ± 0.2	30	37
8 Christian Co., southwestern Missouri	37 ± 5	4.1 ± 0.2	41	26
11 Montgomery Co., west central Arkansas	32 ± 7	4.2 ± 0.3	47	59

1/ The ± figures indicate standard error of the mean.

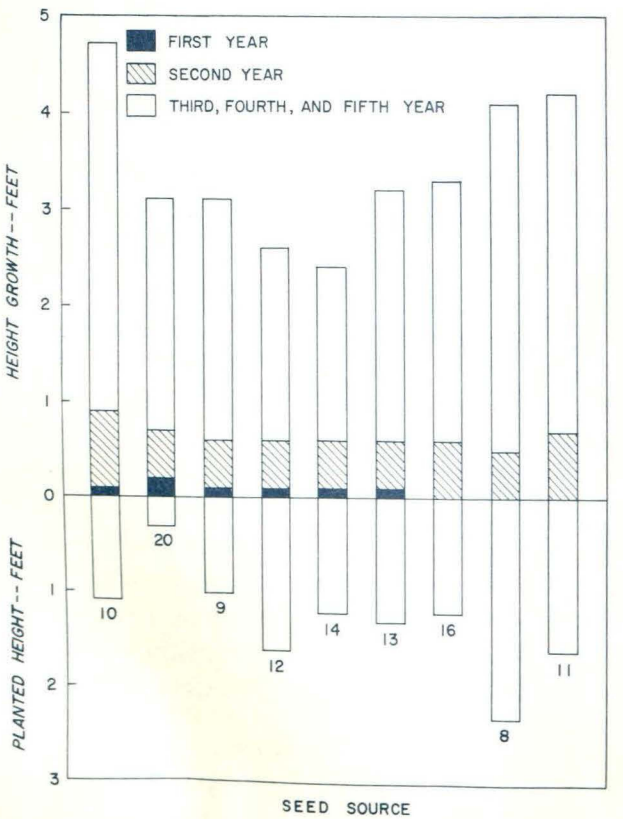

Figure 1.— Height after planting and at end of first, second, and fifth growing seasons.

Vigor

Good — all foliage on tree having a normal, healthy appearance

Fair — one-half or less of foliage dead

Poor — more than one-half of foliage dead

Results

After 5 years, trees from the West Virginia source had the best survival, greatest height growth, and best form (fewest trees with forks) (table 1). Survival of the 1-0 seedlings from the Nebraska source was also good, but almost 50 percent of the trees had poor form. The variation in mean height growth within sources was small and uniform among all sources (± 0.2 to 0.3 ft.). Within-source variation in mean survival was also similar among sources (± 3 to 9 percent).

The seedling-survival patterns of the nine seed sources after the first, second, and fifth growing seasons suggest that the true potential of the Kentucky, Missouri, and Arkansas stock is not indicated by the poor survival after 5 years. In these sources there was high seedling mortality (50 to 60 percent) during the first growing season, followed by a small loss the second year. During the next 3 years, however, there was little or no mortality, suggesting that the great initial mortality was caused by imbalance of top and root.

The height-growth patterns of seedlings of the Kentucky, Missouri, and Arkansas sources also indicate that the roots of these seedlings were too small in relation to the size of the tops (fig. 1). There was no height growth during the first growing season; in fact, many seedlings died back. During the second year, however, these seedlings grew as well as seedlings from the other sources.

The poor survival and growth of seedlings from the two central Kansas sources (12 and 14) was probably a result of the seedlings not being suited to the planting site, rather than because of excessive seedling size. Survival and height growth of seedlings during the first year were as good as those of the West Virginia seedlings. However, mortality was high during the next 4 years, especially in the Trego County, Kansas, source, and growth of the surviving trees was slow.

As might be expected, there was a relationship between the vigor of the trees after 5 years, as expressed by the amount of living foliage, and the height growth. Seedlings from the two sources from central Kansas had the poorest height growth, and also the largest percentage of dying trees. In contrast, the two sources with the fastest growing seedlings — West Virginia and Arkansas — had the greatest percentage of trees in the good vigor category (table 1).

Needle blight fungi (*Cercospora* spp. and *Piricanda* spp.) were found on the dead foliage of the seedlings.[2] It appears that seedlings of the two central Kansas sources were more susceptible to these needle blights than seedlings of the other sources. There was little difference among sources in foliage color or crown shape. The living foliage on all sources was a normal green and most of the trees had a roughly conical shape.

Better survival and growth would probably have resulted if seedlings had been intermediate in size between the small Nebraska 1-0 stock and the large 2-0 stock of the other sources. The 1-0 stock had an average stem diameter at the root collar of 0.07 inches and height of 0.3 feet. In contrast, the Missouri 2-0 stock, which grew at low density because of poor germination, had a root collar diameter of 0.4 inches and a height of 2.3 feet. First-year survival of this large stock with

[2] *Identification of the needle blight fungi was made by Dr. Merton Brown, University of Missouri Pathology Department.*

poor balance between top and root was less than 50 percent. Stoeckeler and Slabaugh[3] recommend that redcedar nursery stock be transplanted after 1 year to produce a more fibrous root system and a top:root ratio of from 2.0 to 3.5. The use of 1-1 transplants or 1-0 seedlings grown at a lower density in the nursery bed would probably increase first-year survival on many of the droughty planting sites in the Missouri Ozarks.

Observations and measurements will be continued to give long-term evaluation of the sources. Growth and survival in the last three growing seasons, during which the impact of planting-stock quality should have been declining, indicate that seedlings from the Arkansas, Missouri, and West Virginia sources will continue to grow vigorously. Until these sources have been more fully evaluated, however, seedlings grown from local seed should be used for planting in the Ozark region.

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[3] *Stoeckeler, J H., and Slabaugh, P E. Conifer nursery practice in the prairie-plains. U.S. Dep. Agr. Handb. 279, 93 p. 1965.*